(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 785 702 A2

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.07.1997 Bulletin 1997/30

(51) Int. Cl.6: **H05B 41/29**

(21) Application number: 96120430.2

(22) Date of filing: 18.12.1996

(84) Designated Contracting States:
BE DE FR GB IT NL

(30) Priority: 16.01.1996 US 585669

(71) Applicant: OSRAM SYLVANIA INC.
Danvers, MA 01923 (US)

(72) Inventors:
- Moskowitz, Warren P.
  Ipswich, MA 01923 (US)
- Olsen, Joseph A.
  Rockport, MA 01966 (US)

(74) Representative: Pokorny, Gerd
OSRAM GmbH,
Postfach 22 16 34
80506 München (DE)

(54) **Methods and apparatus for operating a discharge lamp**

(57) Methods of operating a discharge lamp by amplitude-modulating and pulsing the lamp input power waveform. The techniques control both the arc stabilization and color characteristics of the lamp, respectively. The alternating current (AC) input waveform is amplitude-modulated to stabilize the arc with a swept AC periodic wave (such as a sine wave, sawtooth wave, square wave, etc., or a combination thereof). The swept wave can be generally swept from about 20 kHz to 60 kHz, with a preferable band sweep of from approximately 40 kHz to 50 kHz. The sweep can also be patterned (such as allowing the sweep to have stepped rises and falls within the sweep cycle). The sweep may also contain multiple-frequency sweeps that are bundled together to modulate the carrier wave. These modulation forms are used to center, constrict and stabilize the arc. In addition to this stabilization, the lamp input waveform is pulsed to control and regulate the color characteristics of the lamp.

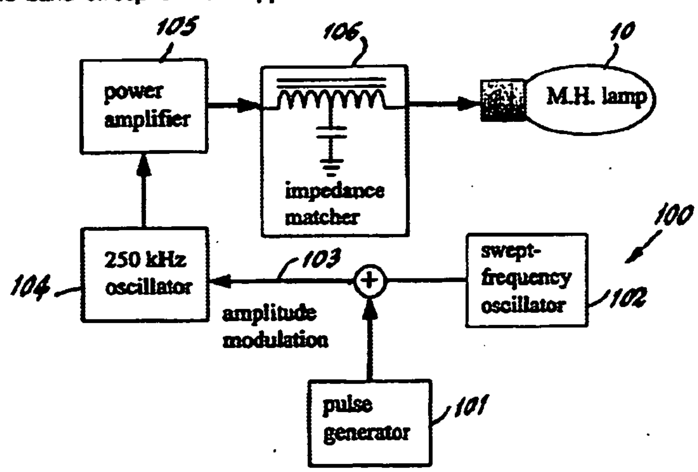

FIG. 2

Printed by Rank Xerox (UK) Business Services
2.14.11/3.4

Description

TECHNICAL FIELD

The present invention pertains to discharge lamps and, more particularly, to methods of stabilizing and controlling the characteristics of discharge lamps, by amplitude-modulating the input alternating current (AC) power wave with a periodic waveform and/or a pulse wave to control both arc stabilization and color characteristics.

BACKGROUND ART

Discharge lamps have been operated in pulsed mode, as illustrated in United States Patent No. 4,904,903 (issued to Pacholok on February 27, 1990, and entitled "Ballast for High Intensity Discharge Lamps"). This patent teaches methods of operating fluorescent, mercury vapor, sodium and metal halide (MH) lamps, so that the input is electronically, periodically gated for a portion of the wave period. This pulsed operation is effective in eliminating undesirable electromagnetic and radio interference emissions.

Color control of high-intensity discharge (HID) lamps by pulsing techniques is also well known in the art, as shown by United States Patent Nos. 4,137,484; 4,839,565; and 4,963,796. Japanese Patent No. 432153 teaches the use of exterior temperature regulation to control the color of its discharge lamp. Other color-controlling methods include interior temperature regulating techniques and varying the salts within the discharge tube.

One of the major problems in the operation of discharge lamps is the deformation of the arc within the discharge tube by convective gas flow. Techniques for stabilizing and centering this arc have been developed. United States Patent No. 5,134,345 (issued to El-Hamamsy et al on July 28, 1992, and entitled "Feedback System for Stabilizing the Arc Discharge of a High Intensity Discharge Lamp"), illustrates a method of avoiding acoustic frequencies that cause destabilizing phenomena. The method of this patent teaches the detection of arc instabilities, and changing the drive frequencies that cause them.

In United States Patent No. 5,306,987 (issued to Dakin et al on April 26, 1994, and entitled "Acoustic Resonance Arc Stabilization Arrangement in a Discharge Lamp"), an arc stabilization technique is illustrated in which the frequency of the drive signal is modulated. A similar method of controlling the arc in discharge lamps is illustrated in United States Patent No. 5,198,727 (issued to Allen et al on March 30, 1993, and entitled "Acoustic Resonance Operation of Xenon-Metal Halide Lamps on Unidirectional Current"). With this method, the arc is centered by the "acoustic perturbations" induced by the frequency of the drive signals. The acoustic perturbations compel the gas or vapor movement patterns to counter the gravity-induced convection.

The present inventors have developed new methods of controlling arc destabilization in HID lamps; these techniques can additionally be added to a method that changes the color characteristics of the lamps. The new color-changing technique pulses the power input to the lamp; its arc is then stabilized by amplitude-modulating the carrier wave with a periodic waveform. In other words, the color-control pulsing is combined with an acoustic centering, constricting and stabilizing of the arc.

DISCLOSURE OF THE INVENTION

It is, therefore, an object of this invention to obviate the disadvantages of the prior art.

It is another object of the invention to enhance the operation of arc discharge lamps.

These objects are accomplished, in accordance with one aspect of the present invention, by the provision of methods of operating a discharge lamp by amplitude- modulating and pulsing the lamp input power waveform. The techniques control both the arc stabilization and color characteristics of the lamp, respectively. The alternating current (AC) input waveform is amplitude-modulated to stabilize the arc with a swept AC periodic wave (such as a sine wave, sawtooth wave, square wave, etc., or a combination thereof). The swept wave can be generally swept from about 20 kHz to 60 kHz, with a preferable band sweep of from approximately 40 kHz to 50 kHz. The sweep can also be patterned, such as allowing the sweep to have stepped rises and falls within the sweep cycle. The sweep may also contain multiple-frequency sweeps that are bundled together to modulate the carrier wave. These modulation forms are used to center, constrict and stabilize the arc. In addition to this stabilization, the lamp input waveform is pulsed to control and regulate the color characteristics of the lamp.

A typical discharge lamp that can use the inventive methodology can comprise a 100-watt metal halide (MH) lamp. Pulse operation of the lamp is different from continuous power operation. During the simmer period between pulses, the lamp runs in an equilibrated, low-power state. When the power pulse is suddenly applied, the time-dependent processes that are involved in reaching a new equilibrium condition for the high-power condition are separated by their individual time constants. An example of this is the domination of the fast-reacting processes, which cause increased light output from mercury emission. In accordance with an aspect of the invention, the power in the pulse is increased while keeping the average power constant. This causes the color temperature and color-rendering index (CRI) to increase at relatively constant intensity. When utilizing this pulsing technique, the arc in the arc tube will normally be forced against the arc tube wall. Without the aforementioned stabilization, this results in damage to the wall, a shortened lamp-life and general deterioration